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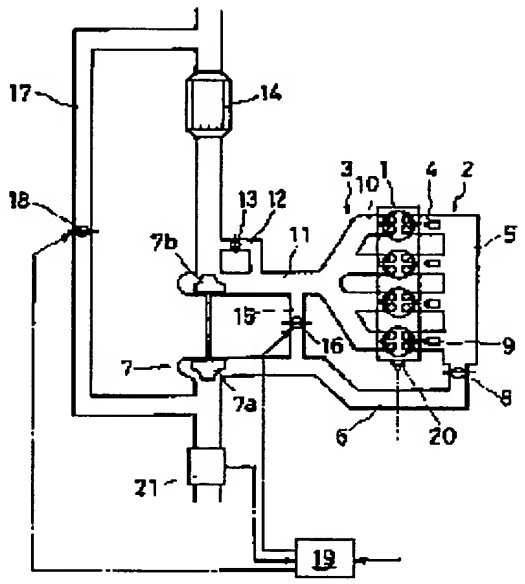
(54) EXHAUST REFLUX DEVICE OF ENGINE WITH TURBO SUPERCHARGER

(57)Abstract:

PURPOSE: To perform exhaust reflux so as to decrease the temperature of exhaust gas without decreasing an fresh air introducing quantity to an engine by controlling exhaust reflux valves in a rotational range for opening a waste gate valve, and in a high rotational high-load range which is close to the limitation of a turbine rotation.

CONSTITUTION: Exhaust reflux passages 15, 17 for communicating the upstream part of a turbine 7b in an exhaust passage 11 with the downstream part of a blower 7a in an intake passage 6, and an exhaust reflux valves 16, 18 for opening/closing these exhaust reflux passages 15, 17 are provided. Turbine rotational speed is arranged to become more than a specified turbine rotational speed on the rotational side higher than the rotational speed in which a waste gate valve 13 starts to open, in the engine rotational speed range for opening the waste gate valve 13. A reflux control means 19 for controlling the exhaust reflux valves 16, 18 to open the exhaust reflux passages 15, 17 in the engine high rotational high-load range like this is provided. Namely, the exhaust gas of a required quantity is introduced by the control of the exhaust reflux valves 16, 18 downstream from the blower 7a so as to decrease the temperature of the exhaust gas.



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CLAIMS

[Claim(s)]
[Claim 1] While having the turbosupercharger which consists of Blois which it is arranged in the turbine and inhalation-of-air path which it is arranged in a flueway and driven with exhaust air energy, and is driven in said turbine It is exhaust air reflux equipment of a turbo supercharged engine with which the bypass path which bypasses said turbine was established in said flueway, and the waist gate valve which opens this path when the boost pressure of the Blois lower stream of a river of said inhalation-of-air path arrives at this bypass path at the predetermined highest charge pressure was prepared. In the exhaust air reflux path which opens the turbine upstream of said flueway, and the Blois lower stream of a river of said inhalation-of-air path for free passage, the exhaust air reflux valve which open and close this exhaust air reflux path, and the engine revolution region as for which said waist gate valve carries out open actuation and In the high-engine-speeds heavy load region where a turbine engine speed turns into more than the predetermined turbine engine speed by the side of high rotation from the engine speed which said waist gate valve begins to open Exhaust air reflux equipment of the turbo supercharged engine characterized by establishing the reflux control means which controls said exhaust air reflux valve to open said exhaust air reflux path.
[Claim 2] A turbine engine speed is exhaust-air reflux equipment of a turbo supercharged engine according to claim 1 with which a waist gate valve shall control an exhaust-air reflux valve from the engine speed which it begins to open so that it is a high rotation side and only fixed width opens said exhaust-air reflux path in the high-engine-speeds heavy load region which becomes more than a predetermined turbine engine speed by the side of low rotation from the turbine rotation limitation for breakage prevention in the control means which controls an exhaust-air reflux valve.
[Claim 3] Exhaust-air reflux equipment of the turbo supercharged engine according to claim 1 which established the 2nd control means which controls said 2nd exhaust-air reflux control valve to open said 2nd exhaust-air reflux path in the 2nd exhaust-air reflux valve which opens and closes the 2nd exhaust air reflux path which opens the turbine lower stream of a river of a flueway, and the Blois upstream of an inhalation-of-air path for free passage, and this 2nd exhaust air reflux path, and the predetermined exhaust-air reflux field of the area outside said high revolution heavy load.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the exhaust air reflux equipment of a turbo supercharged engine.
[0002]
[Description of the Prior Art] With the engines for automobiles etc., in order to perform the exhaust-air reflux (it is called EGR) to an inhalation-of-air system for the purpose of NOx reduction from an engine low-loading region generally by the common operating range applied to an inside load region, the exhaust-air reflux equipment which consists of an exhaust-air reflux valve (it is called an EGR valve) which opens and closes a flueway, the exhaust air reflux path which opens an inhalation-of-air path for free passage, and this exhaust air reflux path is formed.
[0003] by the way, the highest charge pressure by which the engine high-speed full admission engine performance is set up by one for abnormal-combustion control in the case of a turbo supercharged engine -- it is restricted and another is restricted by the exhaust gas temperature limitation for dependability reservation of an exhaust air system. Therefore, it is required to ease an abnormal-combustion limitation for the improvement in an output of an engine, and to raise charge pressure, or to lower exhaust gas temperature. Then, the attempt which is made to perform EGR for exhaust gas temperature reduction in an engine high revolution heavy load region from a low loading region in addition to EGR for the NOx reduction applied to an inside load region is made from the former.
[0004] Apart from it, moreover, like a JP,61-43262,A publication Like the thing which enabled it to perform EGR also in the supercharge field in which an exhaust air reflux path is prepared and inlet-pipe boost pressure turns into positive pressure so that the turbine upstream of a flueway and the Blois lower stream of a river of an inhalation-of-air path may be opened for free passage, and a JP,54-148927,A publication When charge pressure is more than an exhaust pressure in a supercharge type diesel power plant, the exhaust gas of the turbine upstream is introduced into the Blois upstream, and when charge pressure is lower than the exhaust pressure of the turbine upstream, what introduced the exhaust gas of the turbine upstream into the Blois lower stream of a river of an inhalation-of-air path is known.
[0005]
[Problem(s) to be Solved by the Invention] When it was going to perform EGR in a turbo supercharged engine in a high revolution heavy load region for exhaust gas temperature reduction, he was trying to introduce exhaust gas into the Blois upstream with conventional equipment in a high revolution heavy load region by the approach of extending the operating space of the exhaust air reflux equipment for NOx reduction in the load region in low. However, especially for exhaust gas temperature reduction, it is required to perform EGR near a turbine revolution limitation, since it is the field that near [this] a turbine revolution limitation cannot supercharge any more, in having introduced a lot of exhaust gas into the Blois upstream in this field, only in that part, the amount of new air conduction ON will decrease, and engine power will decline.
[0006] Although what introduces exhaust gas into the Blois lower stream of a river as mentioned above is indicated by JP,61-43262,A and JP,54-148927,A, these indicate neither the above-mentioned trouble in the case of performing EGR in the high revolution heavy load region near a turbine revolution limitation for exhaust gas temperature reduction, nor its cure about EGR for NOx reduction.
[0007] This invention is made in view of such a trouble, and it aims at performing exhaust air reflux and reducing exhaust gas temperature, without decreasing the amount of new air conduction ON to an engine in the high revolution heavy load region near the turbine revolution limitation of a turbosupercharger.

[0008]
[Means for Solving the Problem] When it is going to perform exhaust air reflux in a turbo supercharged engine in a high revolution heavy load region for exhaust gas temperature reduction, this invention It finds out that the amount of new air conduction ON decreases as mentioned above in having introduced exhaust gas into the Blois upstream like the exhaust air reflux for the usual NOx reduction, and engine power declines. Moreover, the high revolution heavy load region near especially a turbine revolution limitation needs to reduce exhaust gas temperature by exhaust air reflux, and this field The relation between charge pressure and the exhaust pressure of the turbine upstream is reversed by the waist gate valve by open Lycium chinense. From charge pressure, the exhaust pressure of the turbine upstream is the field which became sufficiently high, and can introduce the exhaust gas of the turbine upstream into the Blois lower stream of a river so much using the pressure differential of the exhaust pressure and charge pressure. It is because the knowledge that exhaust gas temperature could be reduced was acquired, without solving the above-mentioned problem and decreasing the amount of new air conduction ON in the high revolution heavy load region near a turbine revolution limitation by it. And while the configuration is equipped with the turbosupercharger which consists of Blois which it is arranged in the turbine and inhalation-of-air path which it is arranged in a flueway and driven with exhaust air energy, and is driven in said turbine It is exhaust air reflux equipment of a turbo supercharged engine with which the bypass path which bypasses a turbine was established in the flueway, and the waist gate valve which opens this path when the boost pressure of the Blois lower stream of a river of an inhalation-of-air path arrives at this bypass path at the predetermined highest charge pressure was prepared. In the exhaust air reflux path which opens the turbine upstream of a flueway, and the Blois lower stream of a river of an inhalation-of-air path for free passage, the exhaust air reflux valve which open and close this exhaust air reflux path, and the engine revolution region as for which a waist gate valve carries out open actuation And it is characterized by establishing the reflux control means which controls an exhaust air reflux valve to open an exhaust air reflux path in the high-engine-speeds heavy load region where a turbine engine speed turns into more than the predetermined turbine engine speed by the side of high rotation from the engine speed which a waist gate valve begins to open.
[0009] Here, a turbine engine speed shall be a high rotation side from the engine speed which a waist gate valve begins to open, and from the turbine rotation limitation for breakage prevention, it shall more specifically [the control means which controls an exhaust air reflux valve] control an exhaust air reflux valve so that only fixed width opens an exhaust air reflux path in the high-engine-speeds heavy load region which becomes more than a predetermined turbine engine speed by the side of low rotation.
[0010] Moreover, the 2nd exhaust air reflux path which this invention shall also perform the usual exhaust air reflux for NOx reduction, and opens the turbine lower stream of a river of a flueway, and the Blois upstream of an inhalation-of-air path for free passage in that case, The 2nd control means which controls the 2nd exhaust air reflux control valve to open the 2nd exhaust air reflux path in the 2nd exhaust air reflux valve which opens and closes this 2nd exhaust air reflux path, and the predetermined exhaust air reflux field of the area outside a high revolution heavy load is established.
[0011]
[Function] It is the engine revolution region by which a waist gate bubble carries out open actuation, and is controlled by the highest charge pressure predetermined in charge pressure. A turbine engine speed from the engine speed which a waist gate bubble begins to open And the predetermined turbine engine speed by the side of high rotation, Preferably, in the high-engine-speeds heavy load region where only fixed width becomes more than the number of predetermined turbine revolutions by the side of a low revolution from a turbine revolution limitation, an exhaust air reflux valve carries out open actuation, and the exhaust air reflux path which opens the turbine upstream of a flueway and the Blois lower stream of a river of an inhalation-of-air path for free passage is opened. At this time, the exhaust pressure of the turbine upstream is higher than the boost pressure (charge pressure) of the Blois lower stream of a river, therefore by control of an exhaust air reflux valve, can introduce the exhaust gas of requirements into the Blois lower stream of a river through an exhaust air reflux path, and can reduce exhaust gas temperature. Moreover, in order to introduce exhaust gas, without letting Blois pass in this way, the demand workload of a supercharger does not increase. The amount of new air conduction ON decreases, and engine power seems therefore, not to fall.
[0012] Moreover, in the predetermined exhaust air reflux field of the area outside said high revolution heavy load, the exhaust gas from the turbine lower stream of a river of a flueway is introduced into the Blois upstream of an inhalation-of-air path, and NOx reduction is attained by it.

[0013]
[Example] Hereafter, an example is explained to this invention based on a drawing.
[0014] Drawing 1 is the general drawing of one example of this invention. In drawing, 1 is the engine of a serial 4-cylinder engine, 2 is the inhalation-of-air system of this engine, and 3 is an exhaust air system.
[0015] The surge tank 5 with which the inhalation-of-air system 2 of the above-mentioned engine is located in the set section of the independent inhalation-of-air path 4 for every cylinder, and these independent inhalation-of-air path 4, It is what is constituted by the inhalation-of-air path 6 of the upstream linked to the air cleaner which does not illustrate this surge tank 5. Blois 7a of a turbosupercharger 7 is arranged at the inhalation-of-air path 6 of the surge tank 5 upstream. By extracting the inhalation-of-air path 6 in the style of [of a surge tank 5] right above on the lower stream of a river of Blois 7a, the throttle valve 8 which adjusts an inhalation air content is arranged, and the fuel injection valve 9 is arranged at each independent inhalation-of-air path 4, respectively.
[0016] Moreover, the exhaust air system 3 of the above-mentioned engine is what is constituted by the independent flueway 10 for every cylinder, and the flueway 11 of the downstream where these independent flueways gathered. While turbine 7b of the turbosupercharger 7 which drives the above-mentioned Blois 7a is arranged in the flueway 11 of the downstream The bypass path 12 which bypasses this turbine 7b is formed, and the waist gate valve 13 which controls charge pressure by closing motion of this path 12 is arranged at the bypass path 12. Moreover, the catalyst equipment 14 for exhaust gas clarification is arranged on the lower stream of a river of turbine 7b.
[0017] Between the inhalation-of-air system 2 of the above-mentioned engine, and the exhaust air system 3 The 1st exhaust air reflux path which introduces the exhaust gas of the turbine 7b upstream of a flueway 11 into the Blois 7a lower stream of a river of the inhalation-of-air path 6 The 1st exhaust air reflux valve 16 which 15 is prepared [1st], and this path 15 is opened [1st] in this 1st EGR path 15 in an engine predetermined high revolution heavy load region, and makes exhaust gas flow back is arranged. (It is hereafter called an EGR path) Moreover, the 2nd exhaust air reflux path (EGR path) 17 which introduces the exhaust gas of catalyst equipment 14 lower stream of a river of a flueway 11 into the Blois 7a upstream of the Blois 7a upstream inhalation-of-air path 6 of the inhalation-of-air path 6 is formed. The 2nd exhaust air reflux valve (EGR valve) 18 which this path 17 is opened [2nd] in this 2nd EGR path 17 in the predetermined field which lasts to an inside load region from an engine low loading region, and makes exhaust gas flow back is arranged.
[0018] The waist gate valve 16 is opened and closed by the actuator (not shown) which makes a driving source boost pressure of a Blois 7a lower stream of a river, holds down a Blois 7a discharge pressure (charge pressure) to the predetermined highest charge pressure, and prevents breakage of the engine by abnormal combustion. Moreover, two EGR valves, the 1st and the 2nd, 16 and 18 are controlled by the control unit 19. Therefore, an engine revolution signal is inputted into a control unit 19 from the crank angle sensor 20 formed in the engine 1 as control information, and an inhalation air content signal is inputted from the intake air flow sensor 21 formed in the Blois 7a upstream of the inhalation-of-air path 6.
[0019] Drawing 2 shows the regulatory region and the control characteristic of the Blois lower stream of a river EGR which carry out open control of the 1st EGR valve 16 for exhaust gas temperature reduction, and introduce exhaust gas to a Blois 7a lower stream of a river. The high-engine-speeds heavy load region which pulled the slash of drawing is an execution area of the Blois downstream EGR by control of this 1st EGR valve 16. Upper cases are [an engine load and the lower berth] loads, change of charge pressure and the exhaust pressure of the turbine 7b upstream is shown in an upper case, and, as for the axis of abscissa of drawing 2 , the execution area of the above-mentioned Blois downstream EGR is shown in the lower berth, as for the engine speed and the axis of ordinate. Here, WOT is a throttle full admission line. Moreover, N0 is, the engine speed, i.e., the intercepting point, which the waist gate valve 13 begins to open at full throttle, and the broken line on the basis of this intercepting point is a waist gate valve open line (rotational frequencies, such as a turbine). Moreover, the alternate long and short dash line of drawing shows a turbine revolution limitation (rotational frequencies, such as a turbine).
[0020] An engine speed follows on becoming high, an exhaust pressure rises, and charge pressure also goes up until the waist gate valve 13 opens, as shown in drawing 2 . At this time, charge pressure is higher than an exhaust pressure. And if charge pressure reaches the predetermined highest charge pressure, the waist gate valve 13 will be a high revolution side, it will set it more nearly constant [charge pressure] than an aperture and it, and an exhaust pressure will continue lifting as it is. Consequently, from an intercept rotational frequency, it is a high revolution side, pressure relation is reversed, the exhaust pressure becomes higher than charge pressure, and the pressure differential becomes so large that an engine speed is high.

Here, it is a high revolution side from the waist gate valve open line (broken line) of drawing, and, as for the execution area of the Blois lower stream of a river EGR, only fixed width is set as the high revolution heavy load field of the engine near [lines / these / L] a turbine revolution limitation from a turbine revolution limitation on the basis of revolutions of several lines (L lines), such as a turbine by the side of a low revolution. And in this high revolution heavy load field, the 1st EGR valve 16 opens, exhaust gas is introduced into a Blois 7a lower stream of a river, and exhaust gas temperature is reduced by it. In addition, N1 of drawing is an engine speed from which the Blois lower stream of a river EGR begins in SUTORRORU full admission.

[0021] Drawing 3 is charge pressure-Blois flow-characteristics drawing showing the output engine performance at the time of performing exhaust gas temperature reduction of a high revolution heavy load region by the Blois lower stream of a river EGR as mentioned above as compared with the case where the Blois upstream EGR is performed. The lines shown in drawing as a continuous line are rotational frequency lines, such as a turbine. When shifting to an EGR execution area now from the A point of the field which is not performing EGR, in the case of the Blois upstream EGR, it is required to increase the Blois flow rate by the amount of exhaust gas installation, in order to obtain the amount of same new air conduction ON. In that case, the field of A' of drawing serves as a turbine revolution limitation, on the other hand when the Blois downstream EGR is performed, the Blois flow rate is eternal and a turbine revolution limitation serves as a field of A" of drawing. Thus, it is possible for the allowances of charge pressure buildup of a turbine revolution limitation in the field of A" to be large in the case of the Blois lower stream of a river EGR, to be able to perform a large quantity EGR to a thing with the allowances of charge pressure buildup of a turbine revolution limitation in the field of A' small in the case of the Blois upstream EGR, or to aim at improvement in an output at the time of EGR.

[0022]

[Effect of the Invention] Since this invention is constituted as mentioned above, a lot of exhaust air reflux can be performed without decreasing the amount of new air conduction ON to an engine, as exhaust gas installation is carried out at an inhalation-of-air path, without letting Blois pass in the high revolution heavy load region near the turbine revolution limitation of a turbosupercharger, and the improvement in dependability by reservation and exhaust gas temperature reduction of engine power can be reconciled.

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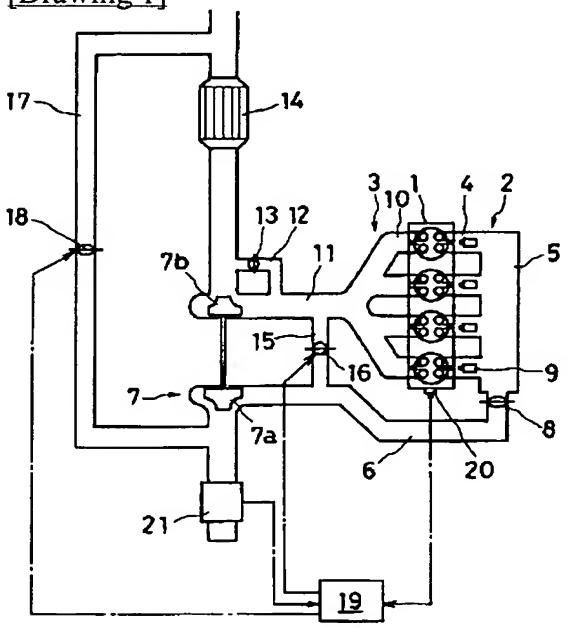
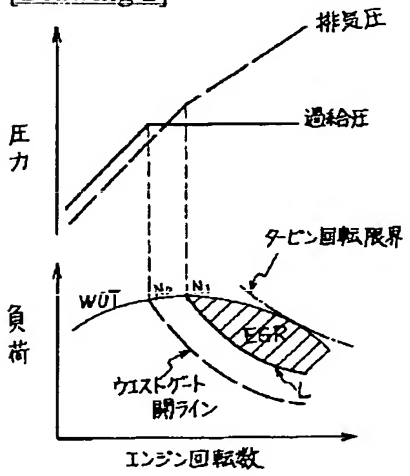
DRAWINGS

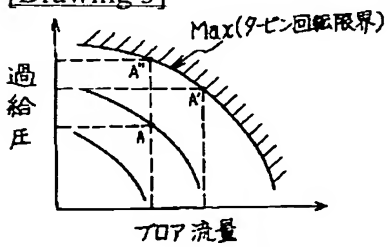
[Drawing 1]



[Drawing 2]



[Drawing 3]



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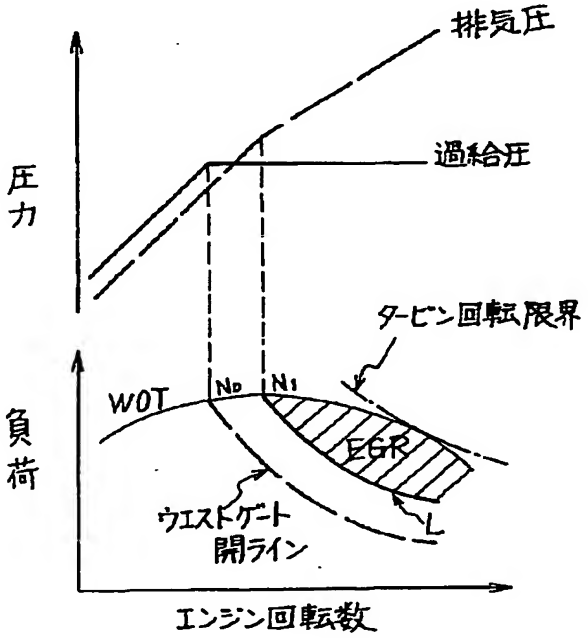
(54)【発明の名称】　ターボ過給機付エンジンの排気還流装置

(57)【要約】

【目的】　ターボ過給機のタービン回転限界に近い高回転高負荷域において新気導入量を減少させることなく排気還流を行い排気ガス温度を低減する。

【構成】　タービン上流の排気ガスをブロア下流に導入するＥＧＲ通路を設け、このＥＧＲ通路にＥＧＲ弁を配置して、所定高回転高負荷域でブロア下流に排気ガスを還流する。このブロア下流ＥＧＲの実行領域は、ウエストゲートバルブ開ラインより高回転側で、タービン回転限界より一定巾低回転側のタービン等回転数ラインを基準として、それよりタービン回転限界に近い高回転高負荷領域に設定する。

【効果】　タービン回転限界付近で新気導入量を減少させることなく多量の排気還流を行い、エンジン出力の確保と排気ガス温度低減による信頼性向上を両立させることができる。



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【特許請求の範囲】

【請求項１】　排気通路に配設され排気エネルギーによって駆動されるタービンと吸気通路に配設され前記タービンによって駆動されるブロアとからなるターボ過給機を備えるとともに、前記排気通路に前記タービンを迂回するバイパス通路が設けられ、該バイパス通路に前記吸気通路のブロア下流のブースト圧が所定の最高過給圧に達したときに該通路を開くウエストゲートバルブが設けられたターボ過給機付エンジンの排気還流装置であって、前記排気通路のタービン上流と前記吸気通路のブロア下流とを連通する排気還流通路と、該排気還流通路を開閉する排気還流弁と、前記ウエストゲートバルブが開作動するエンジン回転域で、かつ、タービン回転数が前記ウエストゲートバルブが開き始める回転数より高回転側の所定タービン回転数以上となるエンジン高回転高負荷域において前記排気還流通路を開くよう前記排気還流弁を制御する還流制御手段を設けたことを特徴とするターボ過給機付エンジンの排気還流装置。

【請求項２】　排気還流弁を制御する制御手段はタービン回転数がウエストゲートバルブが開き始める回転数より高回転側で破損防止のためのタービン回転限界より一定巾だけ低回転側の所定タービン回転数以上となるエンジン高回転高負荷域において前記排気還流通路を開くよう排気還流弁を制御するものとした請求項１記載のターボ過給機付エンジンの排気還流装置。

【請求項３】　排気通路のタービン下流と吸気通路のブロア上流とを連通する第２の排気還流通路と、この第２の排気還流通路を開閉する第２の排気還流弁と、前記高回転高負荷域外の所定排気還流領域において前記第２の排気還流通路を開くよう前記第２の排気還流制御弁を制御する第２の制御手段を設けた請求項１記載のターボ過給機付エンジンの排気還流装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明はターボ過給機付エンジンの排気還流装置に関する。

【０００２】

【従来の技術】自動車用等のエンジンでは、一般に、エンジンの低負荷域から中負荷域にかけての常用運転領域でＮＯｘ低減を目的として吸気系への排気還流（ＥＧＲという）を行うため、排気通路と吸気通路を連通する排気還流通路と該排気還流通路を開閉する排気還流弁（ＥＧＲ弁という）とからなる排気還流装置が設けられる。

【０００３】ところで、ターボ過給機付エンジンの場合に、エンジンの高速全開性能は一つには異常燃焼抑制のため設定される最高過給圧よって制限され、もう一つは排気系の信頼性確保のための排気ガス温度限界によって制限される。したがって、エンジンの出力向上のためには異常燃焼限界を緩和して過給圧を高めるか、排気ガス温度を下げることが必要である。そこで、低負荷域から

2

中負荷域にかけてのＮＯｘ低減のためのＥＧＲに加えて、エンジンの高回転高負荷域において排気ガス温度低減のためにＥＧＲを行うようにする試みが従来からなされている。

【０００４】また、それとは別に、特開昭６１－４３２６２号公報記載のように、排気通路のタービン上流と吸気通路のブロア下流とを連通するよう排気還流通路を設けて吸気管ブースト圧が正圧となる過給領域でもＥＧＲが行えるようにしたものや、特開昭５４－１４８９２７号公報記載のように、過給式ディーゼルエンジンにおいて過給圧が排気圧以上のときはタービン上流の排気ガスをブロア上流に導入し、過給圧がタービン上流の排気圧よりも低いときはタービン上流の排気ガスを吸気通路のブロア下流に導入するようにしたものが知られている。

【０００５】

【発明が解決しようとする課題】ターボ過給機付エンジンにおいて高回転高負荷域で排気ガス温度低減のためにＥＧＲを行おうとする場合に、従来の装置では低中負荷域でのＮＯｘ低減のための排気還流装置の作動領域を広げる方法で高回転高負荷域でブロア上流に排気ガスを導入するようにしていた。しかしながら、排気ガス温度低減のためにはＥＧＲを特にタービン回転限界付近で行うことが必要であり、このタービン回転限界付近というのは、それ以上過給できないという領域であるから、この領域でブロア上流に多量の排気ガスを導入したのでは、その分だけ新気導入量が減少し、エンジン出力が低下してしまう。

【０００６】特開昭６１－４３２６２号公報や特開昭５４－１４８９２７号公報には上記のように排気ガスをブロア下流に導入するものが記載されているが、これらはＮＯｘ低減のためのＥＧＲに関するものであって、タービン回転限界に近い高回転高負荷域で排気ガス温度低減のためにＥＧＲを行う場合の上記問題点やその対策を開示するものではない。

【０００７】本発明はこのような問題点に鑑みてなされたものであって、ターボ過給機のタービン回転限界に近い高回転高負荷域においてエンジンへの新気導入量を減少させることなく排気還流を行い排気ガス温度を低減することを目的とする。

【０００８】

【課題を解決するための手段】本発明は、ターボ過給機付エンジンにおいて高回転高負荷域で排気ガス温度低減のために排気還流を行おうとする場合に、通常のＮＯｘ低減のための排気還流と同様ブロア上流に排気ガスを導入したのでは上記のように新気導入量が減少しエンジン出力が低下してしまうことを見いだし、また、排気還流によって排気ガス温度を低減する必要があるのは特にタービン回転限界に近い高回転高負荷域であって、この領域というのは、ウエストゲートバルブが開くことによって過給圧とタービン上流の排気圧との関係が逆転し、タ

ーピン上流の排気圧が過給圧より十分高くなった領域であって、その排気圧と過給圧の圧力差を利用してタービン上流の排気ガスをブロア下流に多量に導入することができ、それによって上記問題を解決し、タービン回転限界に近い高回転高負荷域において新気導入量を減少させることなく排気ガス温度を低減することができるという知見を得たことによるものである。そして、その構成は、排気通路に配設され排気エネルギーによって駆動されるタービンと吸気通路に配設され前記タービンによって駆動されるブロアとからなるターボ過給機を備えるとともに、排気通路にタービンを迂回するバイパス通路が設けられ、該バイパス通路に吸気通路のブロア下流のブースト圧が所定の最高過給圧に達したときに該通路を開くウエストゲートバルブが設けられたターボ過給機付エンジンの排気還流装置であって、排気通路のタービン上流と吸気通路のブロア下流とを連通する排気還流通路と、該排気還流通路を開閉する排気還流弁と、ウエストゲートバルブが開作動するエンジン回転域で、かつ、タービン回転数がウエストゲートバルブが開き始める回転数より高回転側の所定タービン回転数以上となるエンジン高回転高負荷域において排気還流通路を開くよう排気還流弁を制御する還流制御手段を設けたことを特徴とする。

【０００９】ここで、排気還流弁を制御する制御手段は、より具体的には、タービン回転数がウエストゲートバルブが開き始める回転数より高回転側で破損防止のためのタービン回転限界より一定巾だけ低回転側の所定タービン回転数以上となるエンジン高回転高負荷域において排気還流通路を開くよう排気還流弁を制御するものとすることができる。

【００１０】また、本発明はＮＯｘ低減のための通常の排気還流をも行うものとすることができ、その場合、排気通路のタービン下流と吸気通路のブロア上流とを連通する第２の排気還流通路と、この第２の排気還流通路を開閉する第２の排気還流弁と、高回転高負荷域外の所定排気還流領域において第２の排気還流通路を開くよう第２の排気還流制御弁を制御する第２の制御手段を設ける。

【００１１】

【作用】ウエストゲートバブルが開作動して過給圧が所定の最高過給圧に制御されるエンジン回転域であって、かつ、タービン回転数がウエストゲートバブルが開き始める回転数より高回転側の所定タービン回転数、好ましくはタービン回転限界より一定巾だけ低回転側の所定タービン回転数以上となるエンジン高回転高負荷域では、排気還流弁が開作動し、排気通路のタービン上流と吸気通路のブロア下流を連通する排気還流通路が開かれる。この時、タービン上流の排気圧はブロア下流のブースト圧（過給圧）より高く、したがって、排気還流弁の制御によって排気還流通路を介し所要量の排気ガスをブロア下流に導入し排気ガス温度を低減することができる。また、このようにブロアを通さずに排気ガスを導入するため、過給機の要求仕事量は増大しない。よって、新気導入量が減少してエンジン出力が低下するようなことはない。

【００１２】また、前記高回転高負荷域外の所定排気還流領域では排気通路のタービン下流からの排気ガスが吸気通路のブロア上流に導入され、それによってＮＯｘ低減が達成される。

【００１３】

【実施例】以下、本発明に実施例を図面に基づいて説明する。

【００１４】図１は本発明の一実施例の全体図である。図において１は直列４気筒エンジンのエンジン本体であり、２は該エンジンの吸気系、３は排気系である。

【００１５】上記エンジンの吸気系２は、気筒毎の独立吸気通路４と、それら独立吸気通路４の集合部に位置するサージタンク５と、該サージタンク５を図示しないエアクリーナに接続する上流側の吸気通路６とによって構成されるものであって、サージタンク５上流の吸気通路６にはターボ過給機７のブロア７ａが配置され、ブロア７ａの下流でサージタンク５の直上流には吸気通路６を絞ることによって吸入空気量を調整するスロットルバルブ８が配置され、また、各独立吸気通路４にはそれぞれ燃料噴射弁９が配置されている。

【００１６】また、上記エンジンの排気系３は、気筒毎の独立排気通路１０と、それら独立排気通路が集合した下流側の排気通路１１とによって構成されるものであって、その下流側の排気通路１１には上記ブロア７ａを駆動するターボ過給機７のタービン７ｂが配置されるとともに、該タービン７ｂを迂回するバイパス通路１２が形成され、バイパス通路１２には該通路１２の開閉によって過給圧を制御するウエストゲートバルブ１３が配置されている。また、タービン７ｂの下流には排気ガス浄化用の触媒装置１４が配置されている。

【００１７】上記エンジンの吸気系２と排気系３との間には、排気通路１１のタービン７ｂ上流の排気ガスを吸気通路６のブロア７ａ下流に導入する第１の排気還流通路（以下、ＥＧＲ通路という）１５が設けられて、この第１のＥＧＲ通路１５にはエンジンの所定高回転高負荷域で該通路１５を開いて排気ガスを還流させる第１の排気還流弁１６が配置され、また、排気通路１１の触媒装置１４下流の排気ガスを吸気通路６のブロア７ａ上流吸気通路６のブロア７ａ上流に導入する第２の排気還流通路（ＥＧＲ通路）１７が設けられて、この第２のＥＧＲ通路１７にはエンジンの低負荷域から中負荷域にかけての所定領域で該通路１７を開いて排気ガスを還流させる第２の排気還流弁（ＥＧＲ弁）１８が配置されている。

【００１８】ウエストゲートバルブ１６はブロア７ａ下流のブースト圧を駆動源とするアクチュエータ（図示せ

ず）によって開閉され、ブロア７ａ吐出圧（過給圧）を所定の最高過給圧に抑えて異常燃焼によるエンジンの破損を防止する。また、第１および第２の二つのＥＧＲ弁１６，１８はコントロールユニット１９によって制御される。そのため、コントロールユニット１９には制御情報としてエンジン本体１に設けられたクランク角センサ２０からエンジン回転信号が入力され、吸気通路６のブロア７ａ上流に設けられたエアフローセンサ２１から吸入空気量信号が入力される。

【００１９】図２は排気ガス温度低減のため第１のＥＧＲ弁１６を開制御してブロア７ａ下流へ排気ガスを導入するブロア下流ＥＧＲの制御領域および制御特性を示す。図の斜線をひいたエンジン高回転高負荷域がこの第１のＥＧＲ弁１６の制御によるブロア下流側ＥＧＲの実行領域である。図２の横軸はエンジン回転数、縦軸は上段がエンジン負荷、下段が負荷であって、上段には過給圧およびタービン７ｂ上流の排気圧の変化が示され、下段には上記ブロア下流側ＥＧＲの実行領域が示されている。ここで、ＷＯＴはスロットル全開ラインである。また、N_0はスロットル全開でウエストゲートバルブ１３が開き始めるエンジン回転数すなわちインターセプト点であり、このインターセプト点を起点とした破線がウエストゲートバルブ開ライン（タービン等回転数）である。また、図の一点鎖線はタービン回転限界（タービン等回転数）を示す。

【００２０】図２に示すように、ウエストゲートバルブ１３が開くまではエンジン回転数が高くなるにともなって排気圧が上昇し過給圧も上昇する。このとき、過給圧は排気圧よりも高い。そして、過給圧が所定の最高過給圧に達するとウエストゲートバルブ１３が開き、それより高回転側で過給圧は一定とされ、排気圧はそのまま上昇を続ける。その結果、インターセプト回転数より高回転側で圧力関係が逆転して排気圧の方が過給圧より高くなり、その圧力差はエンジン回転数が高い程大きくなる。ここで、ブロア下流ＥＧＲの実行領域は、図のウエストゲートバルブ開ライン（破線）より高回転側で、タービン回転限界より一定巾だけ低回転側のタービン等回転数ライン（Ｌライン）を基準として、このＬラインよりタービン回転限界に近いエンジンの高回転高負荷領域に設定される。そして、この高回転高負荷領域では第１のＥＧＲ弁１６が開いてブロア７ａ下流に排気ガスが導入され、それによって排気ガス温度が低減される。なお、図のN_1はストッロル全開でブロア下流ＥＧＲが始まるエンジン回転数である。

【００２１】図３は上記のようにブロア下流ＥＧＲによって高回転高負荷域の排気ガス温度低減を行った場合の出力性能をブロア上流ＥＧＲを行った場合と比較して示す過給圧－ブロア流量特性図である。図に実線で示すラインはタービン等回転数ラインである。いま、ＥＧＲを行っていない領域のＡ点からＥＧＲ実行領域へ移行する場合、ブロア上流ＥＧＲの場合は同一新気導入量を得るために排気ガス導入量分だけブロア流量を増大させることが必要で、その場合タービン回転限界となるのは図のＡ’の領域であり、これに対し、ブロア下流側ＥＧＲを行った場合は、ブロア流量は不変でタービン回転限界は図のＡ”の領域となる。このように、ブロア上流ＥＧＲの場合はタービン回転限界がＡ’の領域で過給圧増大の余裕が小さいのに対し、ブロア下流ＥＧＲの場合はタービン回転限界がＡ”の領域で過給圧増大の余裕が大きく、したがって、多量ＥＧＲを行うことができ、あるいはＥＧＲ時の出力向上を図ることが可能である。

【００２２】

【発明の効果】本発明は以上のように構成されているので、ターボ過給機のタービン回転限界に近い高回転高負荷域においてブロアを通さずに吸気通路に排気ガス導入するようにしてエンジンへの新気導入量を減少させることなく多量の排気還流を行うことができ、エンジン出力の確保と排気ガス温度低減による信頼性向上を両立させることができる。

【図面の簡単な説明】

【図１】本発明の一実施例の全体図

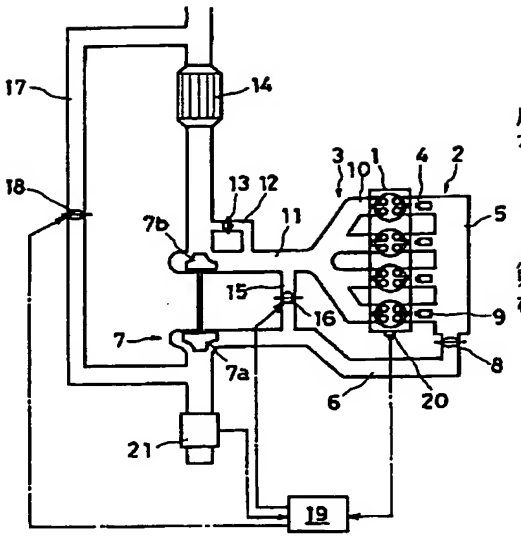
【図２】本発明の一実施例におけるブロア下流ＥＧＲの制御領域および特性説明図

【図３】本発明の一実施例の効果を説明するための過給圧－ブロア流量特性図

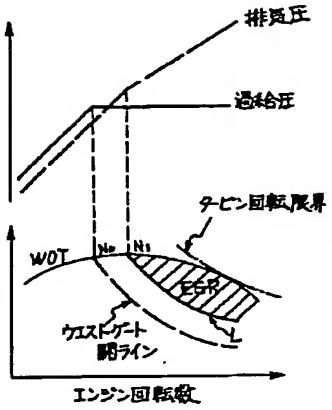
【符号の説明】

１　エンジン本体
６　吸気通路
７　ターボ過給機
７ａ　ブロア
７ｂ　タービン
１１　排気通路
１２　バイパス通路
１３　ウエストゲートバルブ
１５　第１の排気還流通路
１６　第１の排気還流弁
１７　第２の排気還流通路
１８　第２の排気還流弁
１９　コントロールユニット

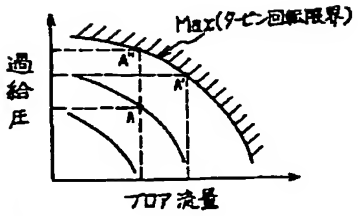
【図１】


17
14
18
13
12
3
10
1
4
2
11
5
7b
15
16
9
7
7a
8
6
20
21
19

【図２】


排気圧
過給圧
圧力
タービン回転限界
WOT
負荷
ウエストゲート
開ライン
エンジン回転数

【図３】


Max(タービン回転限界)
過給圧
A
A'
ブロア流量